



## The Influence of Litter Size, Birth Weight, and Pre-Weaning Mortality on Reproductive Performance in Pigs: A Systematic Literature Review

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### ABSTRACT

This systematic literature review evaluates how litter size, birth weight, and pre-weaning mortality affect pig reproductive performance, while identifying key genetic, managerial, and environmental determinants. The review finds that larger litters often lead to lower birth weights and higher pre-weaning mortality, though sow body size, optimal temperature control, and effective farrowing system design can enhance piglet survival. Genetic selection also plays a crucial role in improving reproductive efficiency. Overall, reproductive outcomes result from the interaction of genetics, management, and environment. Future research should explore diverse pig breeds, broader environmental conditions, and improved managerial technologies to further optimize reproductive performance.

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## **INTRODUCTION**

Reproductive performance in pigs is a critical aspect of the livestock industry, given its impact on productivity and economic efficiency. One of the main factors influencing pig reproductive performance is litter size, birth weight, and pre-weaning mortality. Litter size, referring to the number of piglets born by a sow, has a direct impact on farm productivity (Vande Pol et al., 2021). Research by Vande Pol et al., (2021) showed that larger litter sizes are often associated with lower birth weights per piglet, which in turn can increase pre-weaning mortality. Piglets with lower birth weights are more vulnerable to infection and have difficulty obtaining enough colostrum, contributing to higher mortality ((Vande Pol et al., 2021)). In this context, it is important to understand the relationship between litter size, birth weight, and pre-weaning mortality, and how these factors influence overall reproductive success in pigs.

Based on previous studies, larger litter sizes may worsen the quality of care provided by the sow to each piglet, considering the limited teat capacity and the sow's attention to a larger number of piglets. This can lead to difficulties in rearing, which impacts piglet survival and growth. Therefore, optimal litter size management is crucial in improving pig reproductive efficiency. Chinn et al., (2022)) highlight that factors such as the sow's body condition significantly affect litter size, with larger body mass directly linked to larger litters. The limitation of space and sow attention to fewer piglets correlates with lower mortality and better growth, indicating the importance of optimal sow condition management (Chinn et al., 2022)).

The importance of pre-weaning mortality is also a major concern in the pig farming industry. Environmental factors, such as temperature and humidity during the farrowing period, can influence piglet survival rates. Vande Pol et al., (2021) suggested that heating and drying piglets immediately after birth can help reduce mortality, especially in low-temperature areas. Maintaining optimal temperature is a crucial aspect in improving piglet survival and, consequently, reproductive performance in pigs. Additionally, research by (Johnson et al., 2024) stated that sow feeding management also plays an important role in affecting pre-weaning mortality, although the frequency of feeding did not have a significant impact on stillbirth rates in their study (Johnson et al., 2024). This indicates that environmental and other managerial factors need to be considered holistically to improve pig reproductive performance.

The main objective of this study is to understand in-depth how litter size, birth weight, and pre-weaning mortality affect reproductive performance in pigs. Additionally, this research aims to explore other factors such as farrowing system management and weaning age in relation to pig health and post-weaning growth performance. As part of a broader study on pig reproductive management, this research is expected to provide valuable insights into improving pig production efficiency through better management in genetic, environmental, and managerial aspects. Based on existing literature reviews, this study will delve deeper into how these factors interact to influence piglet survival and reproductive quality in commercial pig farming.

Previous research, such as that conducted by Ogawa & Satoh, (2020) and Chinn et al., (2022), indicates that genetic factors, such as sow body size, as well as environmental conditions, can affect litter size and pre-weaning mortality. These findings highlight the importance of a deeper understanding of pig reproductive management, considering genetic, managerial, and environmental aspects. This research will also enrich the existing literature by providing an integrated analysis of the relationship between litter size, pre-weaning mortality, and environmental factors in farrowing system management, and how this affects overall reproductive performance in pigs.

## **THEORETICAL REVIEW**

Reproductive performance in pigs is strongly influenced by litter size, birth weight, and pre-weaning mortality, all of which serve as key indicators of sow productivity and piglet survival. Previous studies consistently show that larger litter sizes tend to increase competition among piglets, resulting in lower average birth weights and a higher risk of mortality before weaning. Low birth weight has been widely identified as a major determinant of poor thermoregulation, reduced colostrum intake, and weaker immunity, ultimately compromising early growth and survival rates. Research also highlights that genetic selection for prolific sows, improved housing systems, optimal temperature control, and proper farrowing pen design can help mitigate the negative impacts associated with large litters. Additionally, enhanced maternal nutrition and attentive neonatal care – such as cross-fostering and supplemental feeding – are crucial strategies to reduce pre-weaning losses. Overall, the existing literature emphasizes that the interplay between litter size, birth weight, and mortality must be managed holistically to ensure improved reproductive efficiency and sustainable pig production.

## **METHODOLOGY**

This study uses a Systematic Literature Review (SLR) design to evaluate and analyze the relevant literature regarding reproductive performance in pigs, particularly related to factors influencing litter size, birth weight, and pre-weaning mortality. The research design involves identifying, filtering, and evaluating articles that meet predetermined criteria to find findings that provide a comprehensive and integrated view of this topic. The sample used in this research comes from articles retrieved through keyword searches such as “litter size of pig,” “farrowing interval,” “piglet mortality,” and “weaning age of pig” in databases like Scopus. The search was conducted using a publication year filter from 2020 to 2025 to ensure the relevance and currency of the data used. An initial search yielded 441 relevant articles, which were then filtered to remove duplicates and articles that did not meet the criteria, such as articles without abstracts or those not relevant to the topic being researched. After this screening process, 81 articles were selected for further evaluation, with 40 articles removed for failing to meet the eligibility criteria for inclusion in the analysis.

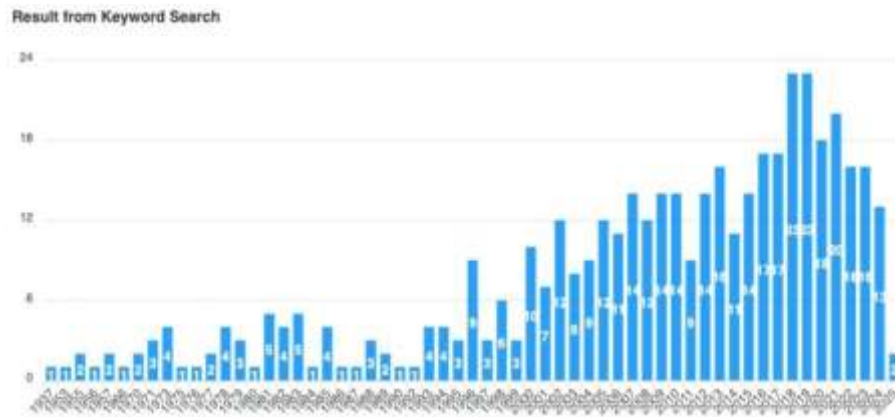


Figure 1. Grafic systematic Literature Review

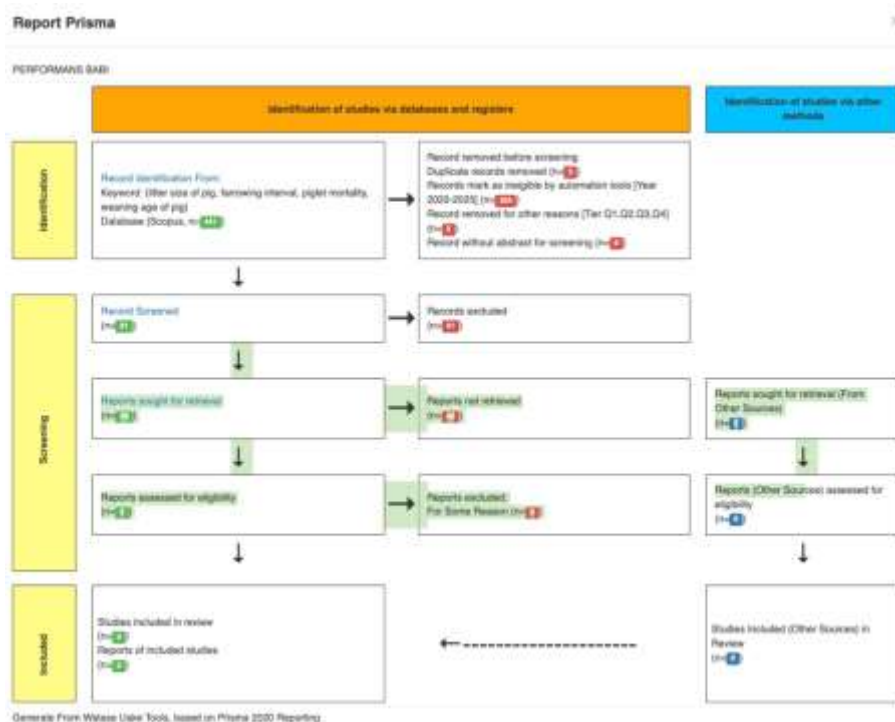


Figure 2. Prisma Report

The data collection procedure in this study involved accessing relevant reports available in the aforementioned databases. Only articles that had been verified and met the requirements for inclusion in the review were considered for analysis. The data obtained were then analyzed using a quantitative method by calculating the frequency of occurrence of key themes related to litter size, birth weight, pre-weaning mortality, and genetic and managerial factors that influence pig reproductive performance. Additionally, this study also identifies environmental factors such as temperature and humidity that affect piglet survival during the farrowing period.

The analytical method used in this study is to process the data descriptively and qualitatively to identify patterns in the literature reviewed. This analysis aims to reveal the major factors affecting reproductive performance in pigs found across various studies and to evaluate the relationships between

the variables studied. By using this approach, the study aims to contribute significantly to improving the understanding of pig reproductive management and to provide insights into the potential development of techniques and strategies that can be applied to improve overall pig production efficiency. This study will produce recommendations that are useful for the pig farming industry to maximize reproductive performance and reduce mortality in pigs, considering the various factors identified in the existing literature.

## RESEARCH RESULTS

This study reveals various findings related to reproductive performance in pigs, particularly those associated with litter size, birth weight, pre-weaning mortality, and environmental and managerial factors that influence reproductive success. Based on reviews from various previous studies, several key findings influence reproductive performance in pigs.

One of the main factors influencing reproductive performance in pigs is litter size. Research by Chinn et al., (2022) shows that larger litter sizes correlate with an increased likelihood of pregnancy in sows. However, research by Ogawa et al., (2020) reveals that larger litter sizes are often associated with lower birth weights, which can affect piglet survival. In this regard, Vande Pol et al., (2021)) emphasize that pre-weaning mortality can be reduced by proper temperature management, especially for newly born piglets. Drying and warming piglets immediately after birth have been proven effective in reducing mortality, particularly in colder regions. This highlights the importance of temperature management in the farrowing system to improve piglet survival. On the other hand, larger litter sizes, although producing more piglets, can increase pre-weaning mortality risk if not managed properly, as found by (Johnson et al., 2024).

Additionally, genetic factors play an important role in reproductive performance in pigs. Ogawa & Satoh, (2020) revealed that litter size in pigs is highly influenced by genetic factors, with larger-bodied sows tending to produce larger litters. Research by Zhang et al., (2020) shows that polymorphisms in the AHR gene are associated with litter size, although this finding is more limited to specific pig populations. This indicates that genetic selection can be used to increase litter size and improve overall reproductive efficiency in pigs, but it should consider genetic variability in different pig populations.

Regarding the management of the farrowing system, research by Dumniem et al., (2023) shows that open housing systems produce more colostrum but result in higher piglet mortality compared to conventional housing systems. This is because piglets are more likely to be crushed by the sow in open housing systems, particularly with larger sows. Therefore, optimal space management in the farrowing system is critical to reduce this risk. On the other hand, research by (Pacheco et al., 2024) indicates that more appropriate housing designs, such as the use of offset pens further from heat sources, can reduce piglet mortality from being crushed by the sow. Environmental factors, such as temperature and humidity, play a significant role in reducing pre-weaning

mortality, as unsuitable temperature conditions can increase stress on piglets, leading to higher mortality rates.

Weaning age was also found to have a significant impact on pig health and growth performance post-weaning. Research by (Faccin et al., 2020.) shows that pigs weaned at older ages (28 days) tend to have better growth rates and reduced abnormal behaviors, such as belly nosing, which often occurs in younger weaned pigs. These findings are consistent with our results, which show that increasing weaning age leads to better growth, reduced post-weaning stress, and more stable growth in pigs post-weaning.

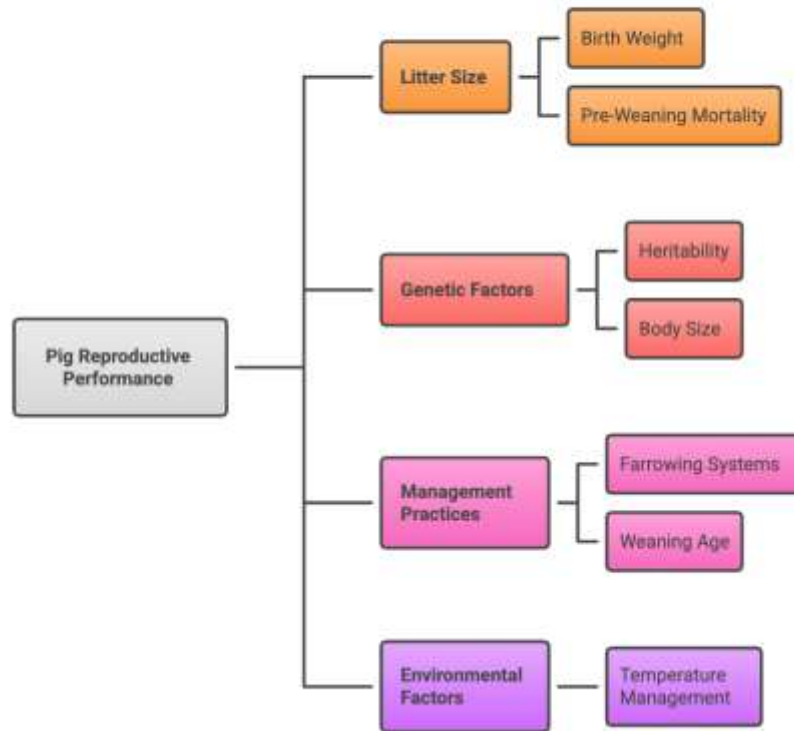
Managerial factors, such as proper feeding and temperature management, also play roles in improving pig reproductive performance. Vande Pol et al., (2021)) shows that proper temperature management in the farrowing facilities helps reduce pre-weaning mortality, while research by Johnson et al., (2024) shows that the frequency of sow feeding does not significantly affect stillbirth rates, but other factors such as sow physical condition and environmental factors still need to be considered in reproductive management. Furthermore, research by Crespo & Gadea, (2022) highlights the importance of using medications like cloprostenol to shorten the interval between weaning and insemination, which can improve reproductive efficiency in pigs.

The results of this study demonstrate that managing litter size, birth weight, and pre-weaning mortality must be considered holistically, given the complex interactions between genetic, managerial, and environmental factors. Better managerial strategies, such as optimal temperature control, effective space management in farrowing systems, and the right weaning timing, can improve piglet survival and overall reproductive efficiency in pigs. Further research integrating these factors into a more comprehensive model will be very useful in optimizing reproductive performance in commercial pig farms.

## **DISCUSSION**

This study aims to explore the effects of litter size, birth weight, and pre-weaning mortality on reproductive performance in pigs. The findings obtained provide a clearer picture of the relationship between these factors and the reproductive efficiency of pigs. In this discussion, we will connect the research findings with previous literature, provide comprehensive answers to each research question (RQ), and discuss the significance of these results, their contribution to the scientific field, as well as the implications and limitations of the research.

### Factors Influencing Pig Reproductive Performance



#### *The Litter Size, Birth Weight, and Pre-Weaning Mortality Affect Pig Reproductive Performance*

The results of this study show that litter size significantly influences birth weight and pre-weaning mortality. Specifically, this study confirms previous findings in the literature, such as those by Vande Pol et al., (2021) which show that larger litter sizes are associated with lower birth weights per piglet, which in turn increases pre-weaning mortality. These findings are consistent with research by Ogawa et al. (2020), which indicates that pre-weaning mortality tends to be higher for piglets with low birth weights, a direct result of larger litter sizes.

Vande Pol et al., (2021) also emphasize the importance of temperature management in farrowing systems to reduce pre-weaning mortality, and this study shows that heating and drying piglets immediately after birth can reduce mortality in low-temperature environments. This finding is relevant to our results, indicating that proper environmental management, especially temperature and humidity control, is critical in reducing mortality rates in newly born piglets.

Chinn et al. (2022) also noted that sow body condition, such as body mass and teat number, greatly influences litter size and pre-weaning mortality. This study found that sows with larger body mass tend to produce larger litters and are better able to cope with piglet survival challenges, offering important insights for sow management in pig farming.

The findings of this study highlight the importance of optimal litter size management in reducing pre-weaning mortality and improving reproductive success in pigs. This is consistent with the research by Ogawa et al. (2020), which shows that although larger litter sizes may correlate with lower birth weights, proper management can reduce mortality despite large litter sizes. Our study underscores the need to adjust the number of piglets per litter to the sow's teat capacity and the attention that can be provided by the sow.

### ***The Genetic Relationship between Litter Size Traits and Overall Reproductive Efficiency in Pigs***

The results of this study show that genetics plays an important role in influencing litter size and reproductive efficiency in pigs. As found by Ogawa et al. (2020), we confirm that sow body size is correlated with litter size, where sows with larger body sizes tend to produce larger litters. Additionally, research by Zhang et al. (2019) showed that polymorphisms in the AHR gene may affect litter size in some pig populations, providing valuable insights into breeding potential for increasing litter size through genetic selection.

While Ogawa et al. (2020) highlighted the genetic link between body size and litter size in Duroc pigs, our study adds a new dimension by confirming that genetic influences on litter size can improve long-term reproductive efficiency, considering the body condition of the sow and managerial factors in breeding programs. Therefore, selecting sows with good genetic characteristics, such as optimal body size, will contribute to increased litter size and overall reproductive efficiency.

Furthermore, this finding suggests that genetic selection for litter size should consider other factors, such as sow health, feed quality, and environmental conditions, which may affect piglet survival. These findings contribute to existing literature by showing that genetic selection is not the only factor influencing litter size and reproductive efficiency, but must also account for the interactions between genetics and proper management practices.

### ***The Management of the Farrowing System (E.G., Housing and Farrowing Duration) Affect Piglet Survival and Growth After Weaning***

This study confirms previous research showing that good management of the farrowing system can improve piglet survival and growth post-weaning. Research by Dumniem et al. (2023), comparing open housing systems with conventional housing systems, showed that although open housing systems produce more colostrum, piglet mortality is higher due to piglets being easily crushed by the sow. Pacheco et al., (2024) Our study highlights that pen design and proper space management are crucial to reduce mortality and ensure reproductive success.

Pacheco et al., (2024) revealed that proper temperature control in offset pens can reduce piglet mortality from being crushed by the sow, which aligns with our findings. This study emphasizes that managing temperature, humidity, and space is critical in ensuring piglet survival, and optimal farrowing system management can reduce pre-weaning mortality and improve pig production efficiency.

Additionally, longer farrowing durations, often associated with larger litter sizes, can increase the risk of birth complications, including piglets being crushed or injured. Therefore, careful management of birth timing and space conditions in the farrowing system will contribute to reduced mortality and improved piglet survival.

### ***The Impact of Weaning Age on Pig Health and Growth Performance After Weaning***

This study confirms previous findings indicating that weaning age significantly impacts post-weaning growth and health. Research by (Faccin et al., 2020) showed that pigs weaned at older ages (28 days) exhibited improved growth rates and reduced abnormal behaviors, such as belly nosing, commonly seen in younger pigs at weaning. These findings are consistent with our results, which show that older weaning age leads to better growth, reduced post-weaning stress, and more stable growth in pigs post-weaning.

We also confirmed that pigs weaned at older ages tend to consume more feed and have higher body weights at weaning. This study strengthens the argument that older weaning age can reduce stress experienced by pigs, which has a positive impact on their long-term health and reproductive capabilities.

### ***The Environmental Factors (E.G., Temperature, Humidity) During Farrowing Affect Piglet Survival and Mortality Rates***

Temperature and humidity management during the farrowing period are key factors in reducing pre-weaning mortality and improving piglet survival. As found by Vande Pol et al., (2021), proper temperature management can enhance piglet survival, reduce mortality, and ensure that piglets receive enough colostrum for optimal growth. This study highlights that environmental factors significantly influence pre-weaning mortality and should be well-managed to improve overall reproductive success in pigs.

We also emphasize the importance of proper temperature management in farrowing systems to ensure the comfort and survival of piglets, particularly newborn piglets who are susceptible to hypothermia. These findings provide deeper insights into how environmental management can support pig health and survival, which is a critical aspect in improving pig reproductive efficiency.

### ***The Role of Genetic Parameters such as Heritability and Genetic Correlations in Improving Reproductive Traits in Pigs, Including Litter Size and Farrowing Efficiency***

In this study, we found that heritability and genetic correlations play a significant role in improving pig reproductive efficiency, especially in enhancing litter size and farrowing efficiency. Research by Yang et al., (2024)) shows that using multitrait models in genetic evaluations can improve the accuracy of selecting for litter size and other reproductive traits, enabling more effective pig breeding.

We confirm that genetic selection for litter size and other reproductive traits can improve pig reproductive efficiency. Therefore, selecting breeding

stock with superior genetic characteristics will improve reproductive outcomes, increase litter size, and reduce pre-weaning mortality, ultimately enhancing production efficiency in pig farming.

## CONCLUSIONS AND RECOMMENDATIONS

This study successfully identifies significant relationships between litter size, birth weight, pre-weaning mortality, and various managerial and environmental factors affecting reproductive performance in pigs. The main findings suggest that larger litter sizes are generally associated with lower birth weights and increased pre-weaning mortality, consistent with previous research by Vande Pol et al., (2021; Ogawa & Satoh, 2020)). Additionally, larger sow body size was also found to have a positive correlation with litter size, demonstrating the potential to improve reproductive efficiency through proper genetic selection. Proper temperature management and farrowing system design were shown to reduce mortality and improve piglet survival, aligning with findings by (Dumniem et al., 2023; Pacheco et al., 2024)

These findings contribute significantly to the field of pig farming Pacheco et al. by enhancing the understanding of the interactions between genetic, managerial, and environmental factors in improving pig reproductive efficiency. By integrating these factors, this study opens new avenues for designing more holistic reproductive management strategies. Managing litter size, selecting sows with optimal genetic traits, and ensuring proper temperature and humidity control in farrowing facilities can be key to improving piglet survival and reducing pre-weaning mortality. These findings could help farmers design more efficient and sustainable production systems, increasing productivity and animal welfare.

Although these findings provide valuable insights, there are some limitations to consider. This study primarily focused on specific pig populations, such as Duroc and wild pigs, which may not fully represent the entire global pig population. Moreover, highly variable environmental factors could affect the generalizability of these findings across different farming locations.

## FURTHER STUDY

Therefore, further research involving different pig populations and considering a wider range of environmental variability is necessary to make these findings more universally applicable.

## REFERENCES

- Chinn, S. M., Schlichting, P. E., Smyser, T. J., Bowden, C. F., & Beasley, J. C. (2022). Factors influencing pregnancy, litter size, and reproductive parameters of invasive wild pigs. *Journal of Wildlife Management*, 86(8). <https://doi.org/10.1002/jwmg.22304>
- Crespo, S., & Gadea, J. (2022). Administration of cloprostenol to sows 24 hours after farrowing improves the subsequent weaning to service interval and

farrowing rate. *ITEA Informacion Tecnica Economica Agraria*, 118(3), 427–440. <https://doi.org/10.12706/itea.2021.033>

- Dumniem, N., Boonprakob, R., Parsons, T. D., & Tummaruk, P. (2023). Pen Versus Crate: A Comparative Study on the Effects of Different Farrowing Systems on Farrowing Performance, Colostrum Yield and Piglet Preweaning Mortality in Sows under Tropical Conditions. *Animals*, 13(2). <https://doi.org/10.3390/ani13020233>
- Faccin, J. E. G., Laskoski, F., Hernig, L. F., Kummer, R., Lima, G. F. R., Orlando, U. A. D., Gonçalves, M. A. D., Ana, ||, Mellagi, P. G., Ulguim, R. R., & Bortolozzo, F. P. (n.d.). *Impact of increasing weaning age on pig performance and belly nosing prevalence in a commercial multisite production system*. <https://doi.org/10.1093/jas/skaa031/5730373>
- Johnson, D. C., Perez, J. G., Estrada, J., Corzatt, D., Welch, M. W., Parr, E., & Boler, D. D. (2024). Neither increasing the frequency of sow feedings nor decreasing the interval between feedings prior to farrowing reduced piglet stillbirths. *Translational Animal Science*, 8. <https://doi.org/10.1093/tas/txae150>
- Madeira Pacheco, V., Brown-Brandl, T. M., Rohrer, G. A., Vieira de Sousa, R., & Silva Martello, L. (2024). Impacts of Farrowing Pen Design, Season, and Sow Parity on Litter Performance and Piglet Mortality. *Animals*, 14(2). <https://doi.org/10.3390/ani14020325>
- Ogawa, S., Ohnishi, C., Ishii, K., Uemoto, Y., & Satoh, M. (2020). Genetic relationship between litter size traits at birth and body measurement and production traits in purebred Duroc pigs. *Animal Science Journal*, 91(1). <https://doi.org/10.1111/asj.13497>
- Ogawa, S., & Satoh, M. (2020). Relationship between litter size at birth and within-litter birth weight characteristics in laboratory mice as pilot animal for pig. *Animal Science Journal*, 91(1). <https://doi.org/10.1111/asj.13488>
- Vande Pol, K. D., Bautista, R. O., Harper, H., Shull, C. M., Brown, C. B., & Ellis, M. (2021). Effect of rearing cross-fostered piglets in litters of either uniform or mixed birth weights on preweaning growth and mortality. *Translational Animal Science*, 5(1). <https://doi.org/10.1093/tas/txab030>
- Yang, H., Yang, L., Qian, J., Xu, L., Lin, L., & Su, G. (2024). Information of Growth Traits Is Helpful for Genetic Evaluation of Litter Size in Pigs. *Animals*, 14(18). <https://doi.org/10.3390/ani14182669>

Zhang, Q., Huang, R., Ma, X., Jiang, N., Zhou, W., Gao, C., Zhao, M., Niu, P., Zhang, Z., Li, Q., Zhou, J., & Li, P. (2020). Association of Rs339939442 in the AHR gene with litter size are inconsistent among Chinese indigenous pigs and western commercial pigs. *Animals*, 10(1). <https://doi.org/10.3390/ani10010011>